(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 512 515 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **92107652.7**

(51) Int. Cl.5: **G01L 5/28**

(22) Date of filing: **06.05.92**

(30) Priority: **07.05.91 IT TO910342**

(43) Date of publication of application:
11.11.92 Bulletin 92/46

(84) Designated Contracting States:
DE ES FR GB SE

(71) Applicant: **FIAT AUTO S.p.A.**
Corso Giovanni Agnelli 200
I-10135 Torino(IT)

(72) Inventor: **Rossi, Carlo**
Via Cimabue, 6
I-10100 Torino(IT)
Inventor: **Canavese, Renato**
Corso Tortona, 31
I-10100 Torino(It)

(74) Representative: **Jorio, Paolo et al**
Studio Torta, Via Viotti, 9
I-10121 Torino(IT)

(54) Apparatus for conducting braking tests on an automobile vehicle provided with a braking system having an anti-skid device.

(57) The apparatus is adapted to conduct braking tests on an automobile vehicle provided with a braking system having an anti-skid device; it substantially comprises a series of rotary rollers (3) each of which is adapted to act as a support for the wheel (4) of the vehicle and first means (5) adapted to vary the force N which is transmitted between the wheel and the roller in the direction substantially perpendicular to the tangent plane between the roller and wheel and second means (21) adapted to generated a tangential force T between the roller and wheel contained substantially in the above-mentioned plane.

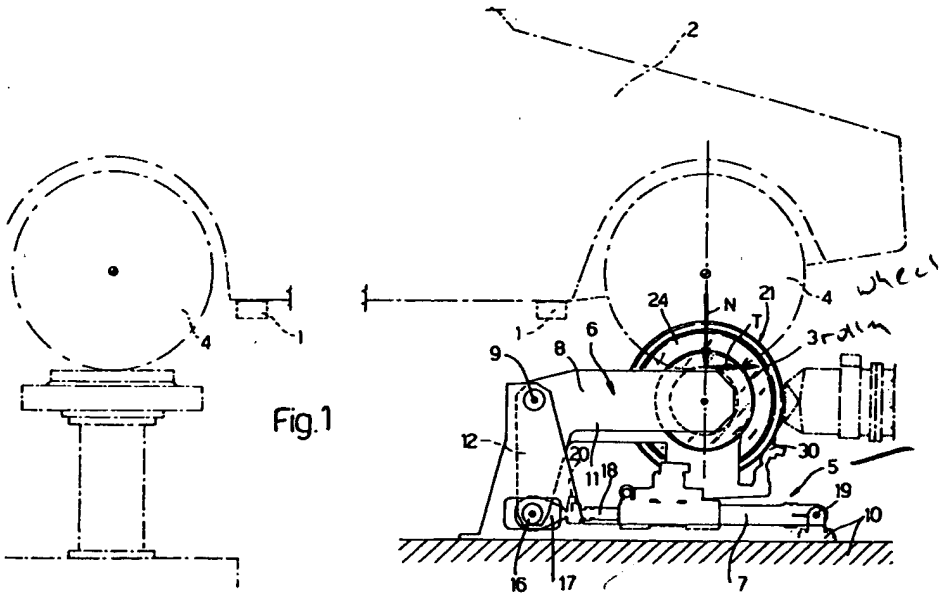


Fig.1

Means to vary F

EP 0 512 515 A1

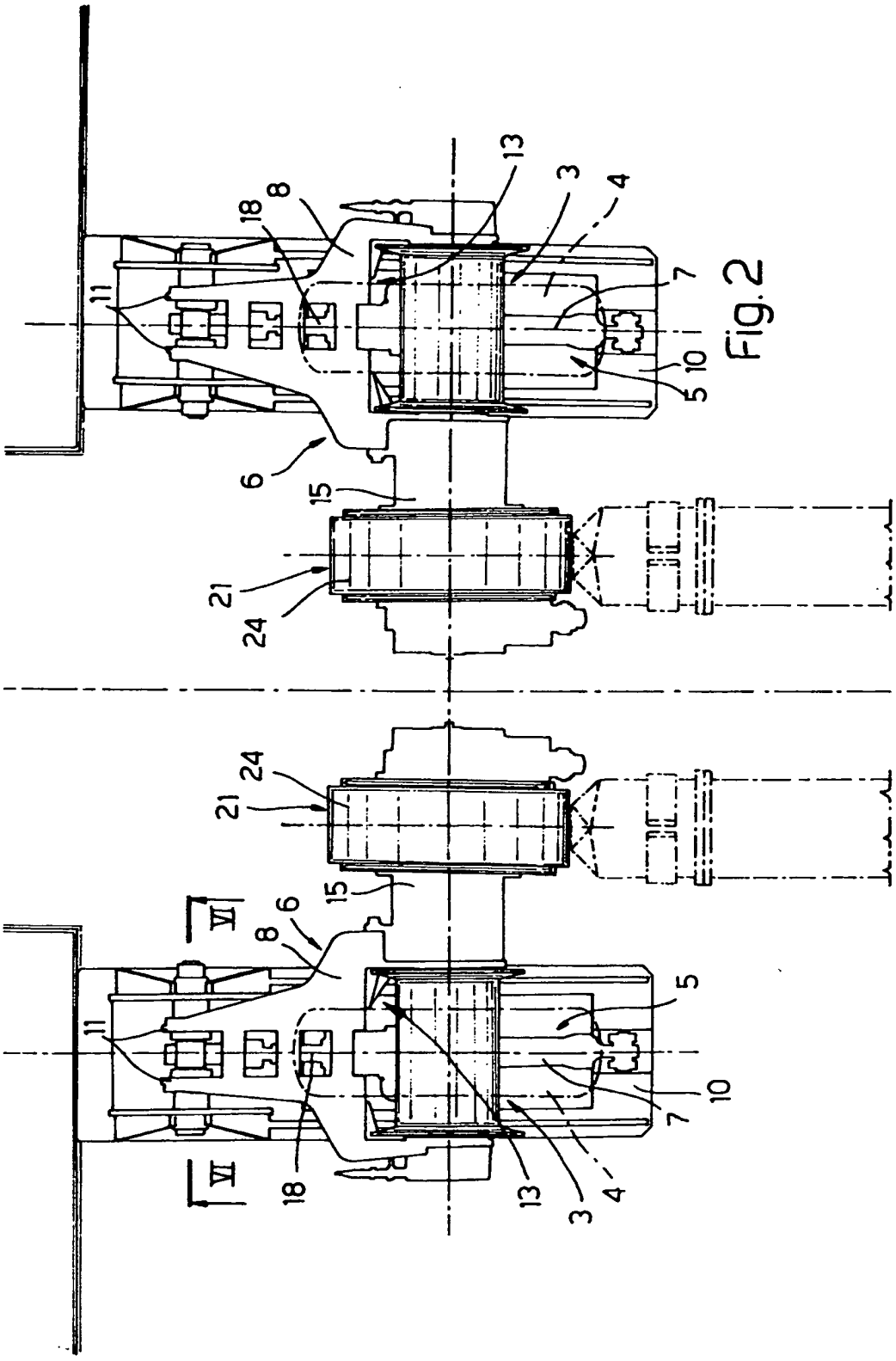


Fig. 2

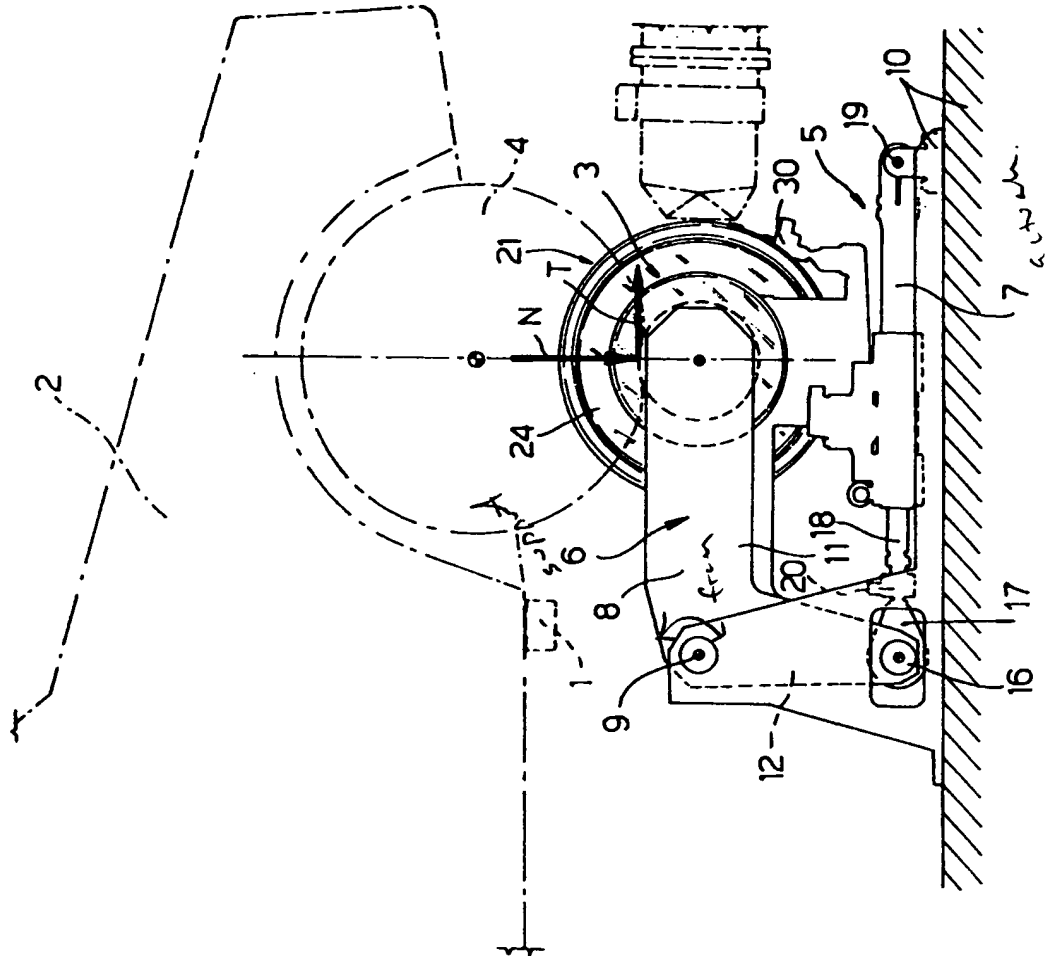


Fig.1

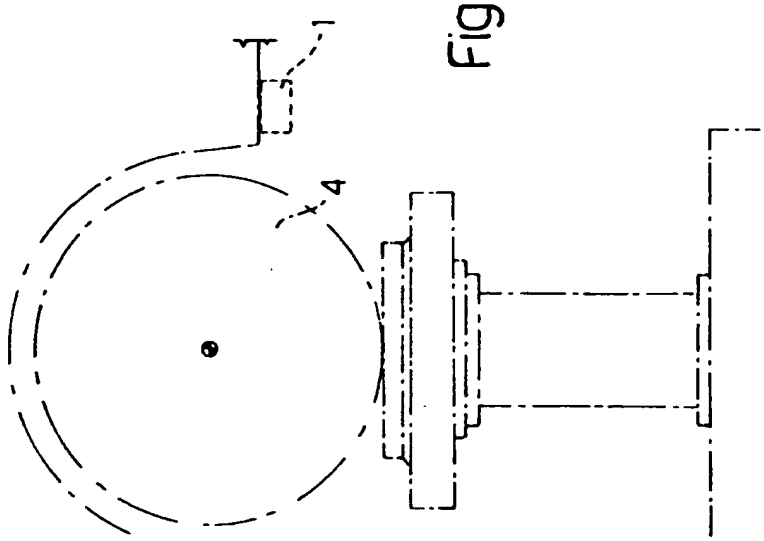
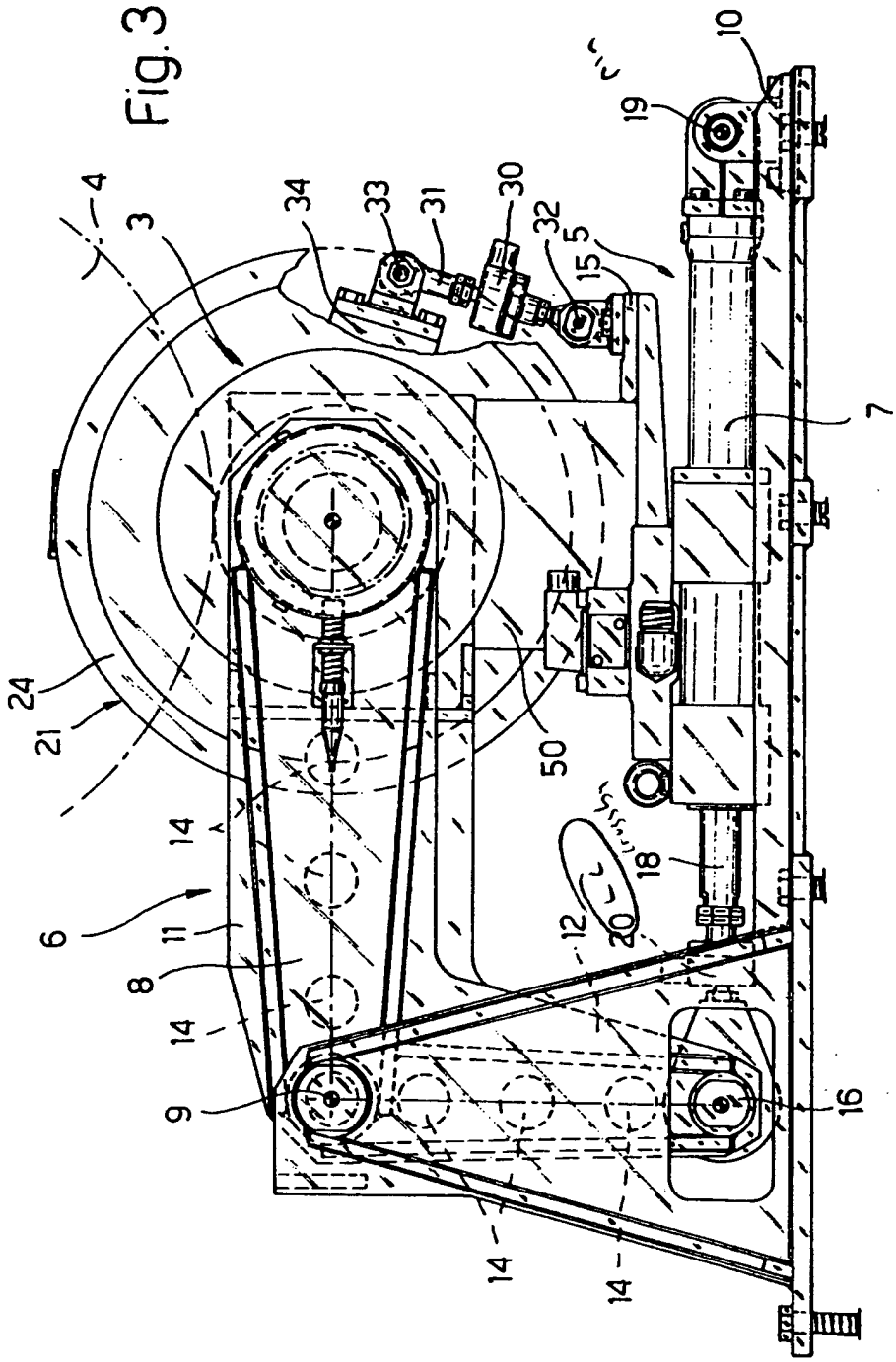


Fig.3



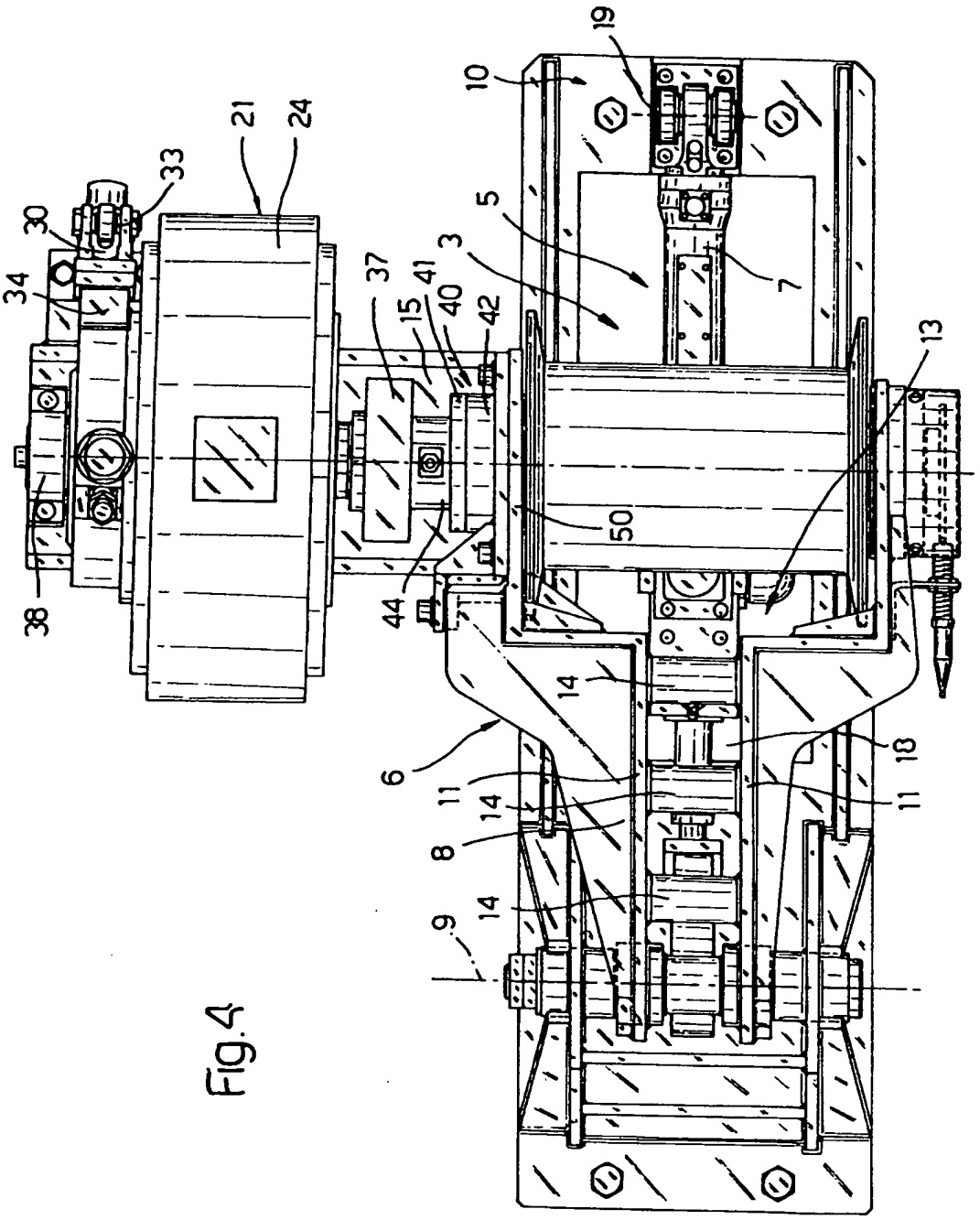


Fig.4

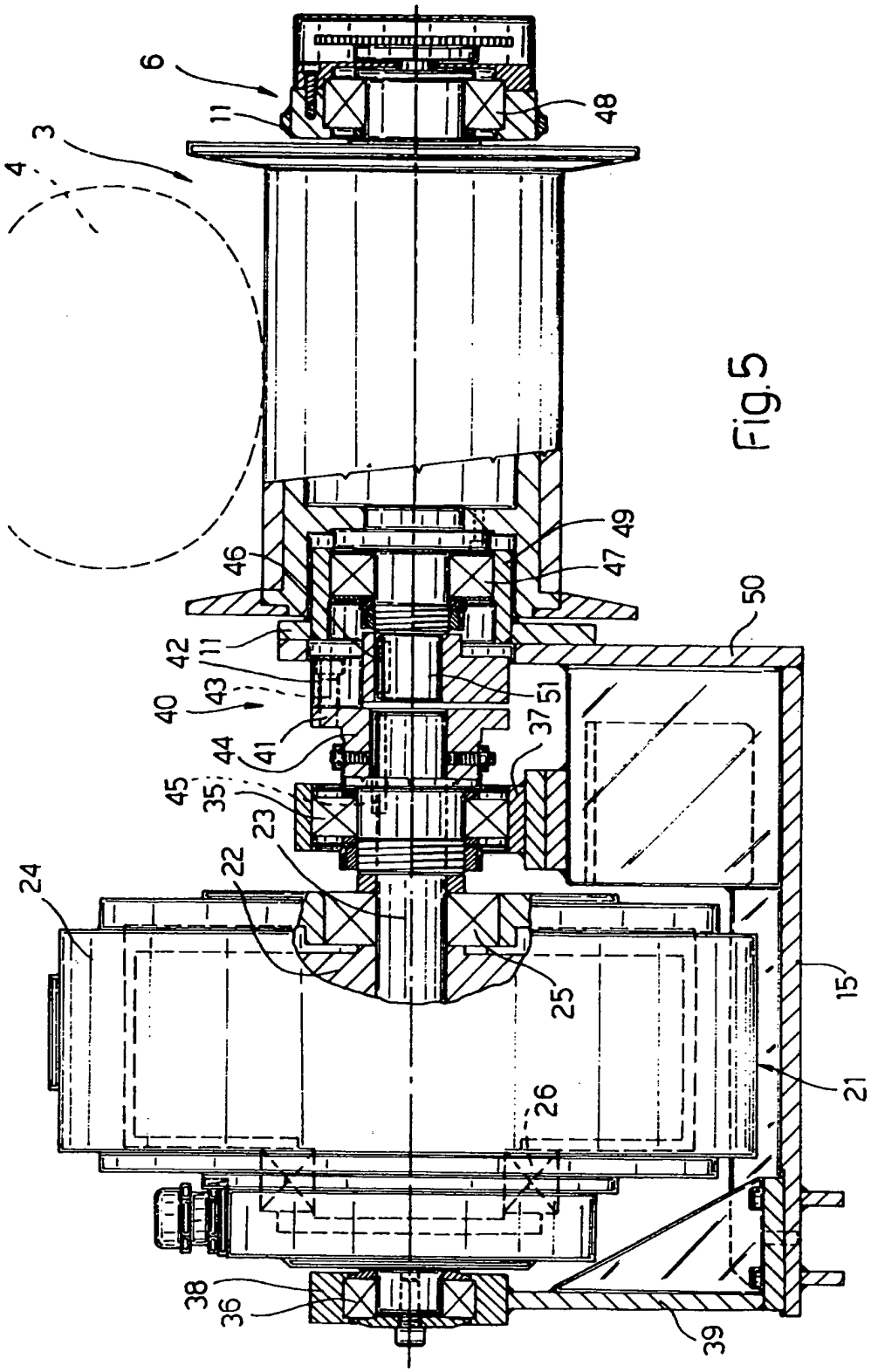

6
11
48
3
4
49
47
46
50
42
11
43
40
51
37
41
44
45
35
23
22
24
25
15
21
26
38
36
39

Fig.5

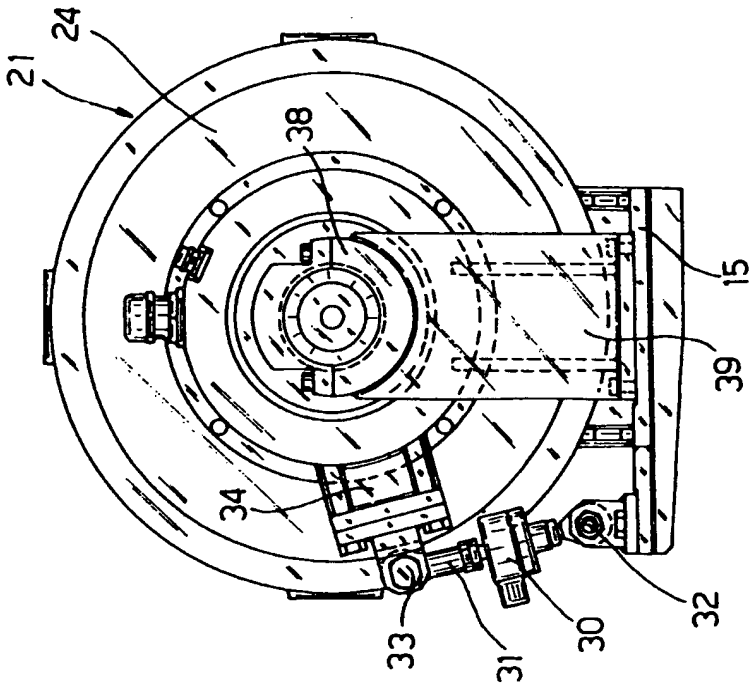


Fig.7

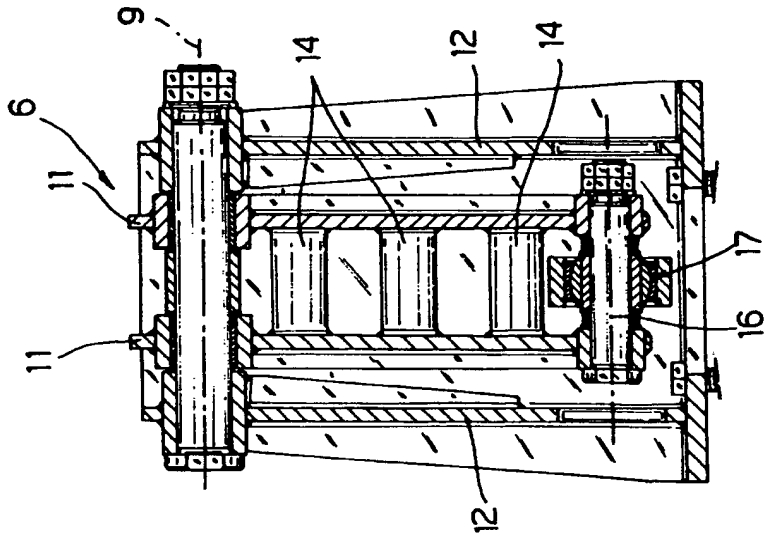


Fig.6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 10 7652

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-0 360 179 (BAYERISCHE MOTOREN WERKE AG) * column 3, line 51 - column 4, line 35; claims 1-6; figures 1,3 *	1,3,5,7	G01L5/28
Y	EP-A-0 367 329 (SUN ELECTRIC SYSTEMS B.V.) * column 2, line 18 - line 28 *	1,5	
Y	US-A-3 206 973 (RICHARD W. OBARSKI) * column 2, line 10 - line 58; figures 1,3 *	3,8	
Y	EP-A-0 331 799 (MASCHINENBAU HALDENMANG GMBH) * column 5, line 11 - line 27; claim 1; figure 1 *	5,7,8	
A	US-A-4 455 866 (ROBERT W.BARRIGAR) * column 5, line 49 - column 6, line 33; claim 1 *	2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			G01L G01M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 JUNE 1992	MUCS A.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)

and 36, the first of which is housed substantially within a support 37 secured to the platform 15 and the second of which is housed within a ring 38 secured to a wall 39 of the platform.

The shaft 23 is connected mechanically to the roller 3 by the mechanical transmission shown in Fig. 5. This transmission substantially comprises a joint 40 which has a pair of coaxial flanges 41 and 42 disposed opposite one another and connected by a series of screws 43. The flange 41 is rigid with a bushing 44 which acts as a seat for the bearing 35 and in the interior of which is inserted the end of the shaft 23: the connection between the shaft and bushing takes place via a tongue 45. The other flange 42 is provided with a boss within which is inserted a pin 46 rigid with the roller 3; the connection between the shaft and bushing takes place via a tongue 51. The roller 3 is supported by a pair of rolling bearings 47 and 48, the first of which is housed within a sleeve 49 fixed to a wall 50 of the platform 15 and the second of which is housed in a seat provided in the end of one of the arms 11 (Fig. 5) of the frame 8.

Rather than an electric motor, the motor 21 may be a hydraulic motor whose casing 24 forms the stator member oscillating with respect to the platform 15 of the apparatus. The torque between the stator member and platform may be measured in this case as well by the load cell 30 (Fig. 7) since the tubes for the supply and discharge of the hydraulic fluid do not impede the free oscillation of the stator member with respect to the platform 15.

In an alternative embodiment of the apparatus of the invention, the means adapted to generate the tangential force T (Fig. 1) between the wheel and roller comprise a brake (shown by the same numeral 21) rather than a motor 21, which brake is adapted to brake the rotation of the roller 3. In this case the roller 3 is caused to rotate by a drive wheel 4 of the vehicle.

When the motor 21 is replaced by a brake, the latter also has the structure of the motor and comprises a rotor member 22 connected to the roller 3 and a stator member 24 coaxial with the latter and oscillating on the platform 15. In this case the load cell 30 which is interposed between the rotor member 24 and the scaffolding 15 is adapted to measure the braking torque generated by the brake 21 and thus the torque between the stator member 24 and the rotor member 22.

The apparatus operates as follows.

The vehicle is placed on the support 1 at a predetermined height with respect to the means 5 in a configuration such as to place the axis of the wheel 4 and the axis of the relative roller 3 in substantially the same vertical plane as shown in Fig. 1. By acting on the actuator 7 the frame 8 is caused to rotate about the axle 9 so as to bring the roller 3 against the wheel 4. By adjusting the force generated by the actuator 7 (when the latter is formed by a hydraulic cylinder, the pressure within this cylinder) a desired normal force N between the roller 3 and wheel 4 may be generated which is contained in the vertical plane perpendicular to the common tangent plane between the roller and wheel.

At this point the electric motor 21 is actuated to control the rotation of the roller 3: when the wheel 4 is braked by acting on the brakes on the vehicle 2 being tested, a tangential force T is also generated whose maximum value, on reaching the limit condition of adhesion between the wheel 4 and the roller 3, is substantially equal to the product of the normal force N times the coefficient of friction caused by the contact between the wheel and roller.

It is evident that by appropriately adjusting the force generated by the actuator 7 the value of the force N and consequently the value of the tangential force T proportional thereto may be varied. In this way it is possible to generate any tangential force T (even of a very small value) such as that encountered in any real driving condition on a road (for instance on an icy road).

It is therefore evident that the apparatus of the invention makes it possible to generate tangential forces of friction T of any desired value, not by acting on the value of the coefficient of friction as is normally the case in normal driving conditions on the road, but on the value of the normal force N between the wheel 4 and roller 3.

The value of the tangential force T between the wheel and roller may be evaluated by the load cell 30 which measures the torque between the rotor member 24 and the stator member 22, which torque is directly proportional to the value of the tangential force T.

It is evident that the tangential force T may be generated, rather than by driving the roller 3 in rotation via the motor 21, by driving the roller in rotation via the wheel 4 (which has in this case to be a drive wheel) and braking the rotation of the roller by a brake 21 which replaces the motor. In this case as well the torque between the rotor member 24 and the stator member 22, measured by the load cell 30, is directly proportional to the tangential force T between the wheel 4 and roller 3.

It is evident that modifications and variants may be made to the embodiment of the present invention described without departing from the scope of the invention.

Claims

1. An apparatus for conducting braking tests on an automobile vehicle provided with a braking

The present invention relates to an apparatus for conducting braking tests on an automobile vehicle provided with a braking system having an anti-skid device.

The behaviour of a vehicle braking system having an anti-skid device is normally tested by road tests where the vehicle is driven on roads offering a wide range of driving conditions and tyre surface adhesion. These tests may be needed either to monitor the performance of a new braking system or simply to monitor the correct operation of the anti-skid device after it has been mounted on the vehicle.

The object of the present invention is to provide a device for conducting braking tests on an automobile vehicle provided with a braking system having an anti-skid device which allows the reproduction of those operating conditions encountered in practice, in this way obviating the need for road tests and offering a multiplicity of operating conditions which is more wide-ranging than that which can be obtained using direct road tests.

This object is achieved by an apparatus for conducting braking tests on an automobile vehicle provided with a braking system having an anti-skid device, characterized in that it comprises a series of rotary rollers, each of which is adapted to form a support for a vehicle wheel, first means adapted to vary the force transmitted between the wheel and the roller in the direction substantially perpendicular to the tangent plane between the roller and wheel and second means adapted to generate a tangential force between the roller and wheel contained substantially in this plane.

The structure and operating methods of the apparatus are now described in further detail, by way of example, with reference to the accompanying drawings, in which:

Figs. 1 and 2 are diagrammatic side and plan views of the apparatus of the invention;

Figs. 3 and 4 are side and plan views of part of the apparatus of the invention;

Fig. 5 is a side view in partial section of the basic mechanical assembly of the apparatus of the invention;

Fig. 6 is a cross-section through the apparatus of Fig. 2 along the line VI-VI of Fig. 2;

Fig. 7 is a side view of the basic mechanical assembly of the apparatus.

In Fig. 1 the apparatus of the invention substantially comprises a support 1 adapted to support an automobile vehicle 2 in a predetermined vertical position and a series of rotary rollers 3, each of which is adapted to act as a support for a wheel 4 of the vehicle. The series of rotary rollers may comprise only two rollers, as shown in the apparatus illustrated in the Figures, or four rollers each of which acts as a support for a corresponding wheel of the vehicle.

The apparatus further comprises means adapted to vary the force N (Fig. 1) which is transmitted between each wheel 4 and the relative roller 3 in the direction substantially perpendicular to the tangent plane between the wheel and roller; these means are shown overall by 5.

The apparatus further comprises means adapted to generate a tangential force T (Fig. 1) between the wheel and roller contained substantially in the above tangent plane; these means may be embodied in different ways as described below.

The means for varying the force N transmitted between the wheel 4 and roller 3 substantially comprise a support 6 for each roller 3, which is movable via the action of an actuator 7 adapted to bring the roller to act on the wheel. Each support 6 advantageously comprises a frame 8 oscillating about an axle 9 on the scaffolding 10 of the apparatus. This frame has two pairs of arms 11, 12 (Figs. 2 and 4) which are substantially perpendicular to one another; the two arms 11 form a fork 13 (Fig. 2) adapted to support one of the rollers 3 in rotation; the other two arms 12 are connected by pegs 14 and by a pin 16 (Fig. 6) which is hinged, by a spherical bearing 17, on a crossbar 18 (Fig. 3) which is in turn hinged on the scaffolding 10 by a hinge pin 19. The actuator 7 and a load cell 20, adapted to measure the axial force acting along the crossbar, form part of the crossbar 18. The actuator 7 is advantageously formed by a hydraulic cylinder whose casing is hinged on the scaffolding 10 by the pin 19 and whose rod generates the central portion of the crossbar 18.

The means adapted to generate the tangential force T between the wheel 4 and roller 3 substantially comprise a motor 21 (Fig. 5) which is adapted to drive the roller in rotation. The motor 21 which is advantageously an electric motor comprises at least one rotor member 22 which is provided with a shaft 23 connected mechanically to the roller 3 and a stator member 24 coaxial with the rotor member which oscillates on a platform 15 borne by the fork 13 (Fig. 4) of the frame 8. The stator member 24 is supported on the rotor member 25 by rolling bearings 25 and 26, the first of which is interposed between the stator 24 and the shaft 23 and the second between the stator 24 and the rotor 22. As shown in Fig. 7, a second load cell 30 adapted to measure the torque transmitted between the stator member and the platform is interposed between the rotor member 24 and the platform 15. The above cell advantageously forms part of a crossbar 31 whose ends are hinged by pins 32 and 33 on the platform and on a member 34 for rigid connection to the stator member 24 respectively.

The shaft 23 of the rotor member 22 is supported on the platform 15 by a pair of bearings 35

system having an anti-skid device, characterized in that it comprises a series of rotary rollers (3), each of which is adapted to form a support for a vehicle wheel (4), first means (5) adapted to vary the force N transmitted between the wheel and the roller in the direction substantially perpendicular to the tangent plane between the roller and wheel and second means (21) adapted to generate a tangential force T between the roller and wheel contained substantially in this plane.

2. An apparatus as claimed in claim 1, characterized in that the first means (5) comprise a support (1) for the vehicle bodywork adapted to hold it in a predetermined vertical position with respect to the rollers (3) and a support (6) for each of these rollers which can be moved by actuating an actuator (7) to bring the roller to act on the relative wheel.

3. An apparatus as claimed in claim 2, characterized in that the support (6) for each of the rollers comprises a frame (8) oscillating on a scaffolding (10) of the apparatus, this frame substantially comprising two pairs of square arms (11, 12), two of which (11) form a fork (23) adapted to support one of the rollers (3) in rotation and the other arms (12) are hinged on a crossbar (18) which is in turn hinged on the scaffolding (10), the actuator (7) being adapted to vary the length of this crossbar.

4. An apparatus as claimed in claim 3, characterized in that a load cell (20) adapted to measure the axial force acting on this crossbar forms part of the crossbar (18).

5. An apparatus as claimed in one of the preceding claims, characterized in that the second means (21) adapted to generate a tangential force T between the wheel and roller comprise a motor (21) adapted to drive the roller in rotation.

6. An apparatus as claimed in claim 5, characterized in that the motor (21) comprises a rotor member (22) connected to the roller (3) and a stator member (24) coaxial with the latter and oscillating on a platform (15) borne by the fork (13), a second load cell (30) adapted to measure the torque transmitted between the stator member and the rotor member being interposed between the stator member (24) and the platform (15).

7. An apparatus as claimed in one of claims 1 to 4, characterized in that the second means (21) adapted to generate a tangential force T between the wheel and roller comprise a brake (21) adapted to brake the rotation of the roller.

8. An apparatus as claimed in claim 7, characterized in that the brake (21) comprises a rotor member (20) connected to the roller (3) and a stator member (24) coaxial with the latter and oscillating on the platform (15), a second load cell (30) adapted to measure the torque transmitted between the stator member and the rotor member being interposed between the stator member (24) and the platform (15).